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Letter to Editor

STRENGTH DIAGNOSIS IN ELITE SPANISH CLUBS TEAMS

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Dear Editor-in-chief

The principal objective of the tests is to provide data which identify specific areas of relative deficiency than can be used to determine individual training programmes (Wilson and Murphy, 1996). In team sports, specific test field associated to the muscular explosive power, as 10-m sprint performance and throwing or shooting velocity, have advantage to predict match performance and to determine the effect of training. However, with these tests the physical conditioning coach (PCC) has difficulty discerning the neuromuscular processes that determine the results. In consequence, specific tests have less validity to guide the training program. The applied engineering to sports has developed the necessary technology to determine, in dynamic movements, some variables that can be used to guide the strength training. The encoder permits to measure the displacement time of the bar and therefore using a finite differences algorithm to determine velocity and acceleration data, the force, and the power. This permits a great variability of practical applications in the control of strength training (i) determining force-velocity curve, power-load curve, force deficit, and the optimal load for maximum mechanical power, in each exercise, athlete and moment of season (Izquierdo et al., 2002), and (ii) examining at different loads the repetition velocity during the sets of repetitions in each exercise, athlete and moment of season (Izquierdo et al., 2006). Resistance ballistic training results in superior loading conditions for the neuromuscular system, greater force and power production (Cronin et al., 2003). Therefore, strength analysis with ballistic technique can be relevant in the control of training program. The technology required for the evaluation of ballistic resistance exercises of the arms is recent and requires a

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complex modification of the Smith Machine. However, a machine was designed 30 years ago for the evaluation of ballistic exercises of the lower extremities (platform of contact). With regard to this matter, Bosco designed a variety of vertical jump tests in order to evaluate neuromuscular processes. The principal purpose of these important technological advances is its application in the daily practice of athletic´s training. However, nothing is known about strength technologies employed by the PCCs.

We administer by means of personal interview a survey to the PCCs of the male team that participated during the 2004/05 season in the top division Spanish league of handball, basketball, volleyball, futsal, soccer and field hockey in order to know their programs of training. The response rate was 81.8% (77 out of 94). In relation to the strength diagnosis, we were interested in knowing the percentage of teams than utilize the encoder and the platform of contact. The PCCs that declared use the encoder and/or the platform of contact were invited to indicate the tests performed and the number of times that utilize both technologies during the season. The current study protocol was approved by the Research Ethics Committee of the Government of Aragón (Spain). All subjects gave written informed consent. The encoder was utilized by a 15.6% of the PCCs to measure the maximum power with different load intensities. No one of the PCCs used the encoder to measure the repetition velocity (Table 1). This is of special interest due to than only with the encoder it is possible to know the repetition velocity in the resistance training sessions. Today, some authors stand out that to perform at maximum velocity, only repetitions that permit maintenance of the maximum power are essential for an optimum transfer of the resistance training to the strength manifestation in specific motor skills (Legaz-Arrese et al., 2007), and can probably prevent the conversion of fibers type IIB to IIa that is inherently related with resistance training (Fry, 2004). It is known that the maintenance of an optimum power for a same RM load differ significantly between exercises, and probably between different athletes (Legaz-Arrese et al., 2007). It is confirmed that different rest periods lengths influence the fatigue in continuous sets of the same exercise, determining the number of repetitions performed, and the decrease in muscular power (Legaz-Arrese et al., 2007).

A high percentage of the PCCs used of the platform of contact (51.9%). The two vertical jump height tests more used were the countermovement jump (CMJ) (49.4%) and the squat jump (SJ) (41.6%) (Table 1). SJ and CMJ height are highly related with specific sprint performance (5-10-20-30 meters) (Cronin and Hansen, 2005). However, the more important is that relating SJ and CMJ height we can calculate the elasticity index (Bosco et al., 1986). Due to than the reutilization of elastic energy is greater with a fast stretch-shorten cycle (SSC) (Bosco et al., 1986), a player with an optimal SJ height and poor elasticity index should based the trainer in plyometric exercises, whereas players with relatively good elasticity index but poor SJ height should achieve the best performance gains thought the use of exercises with slow SSC. Another jump tests were indicated by a lower percentage of the PCCs, CMJ with the arm swing (CMJA) (26.0%), bounce drop jump (BDJ) (20.8%), and loaded CMJ (LCMJ) (9.1%) (Table 1). We consider that the CMJA adds new information, implicating a complex movement that it is similar to the jumps performed in handball, volleyball and basketball play. A deficit in the relation CMJA/CMJ height can be indicative of poor inter-muscular coordination. The BDJ performance is not related with specific sprint performance (Cronin and Hansen, 2005). However, in basketball and volleyball play, some jumps have similar knee flexion and SSC than the BDJ test. In both sports, BDJ should be realized to train and assess the specific muscular SSC function. In relation to the specific test field, probably the jump test than can contribute the information added more useful in order to evaluate the effect of strength training is the execution of SJ or CMJ with progressive increment of load. This

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test contributes in a ballistic movement the relation load-height, an indirect measure of the force-velocity curve, and the power-load curve. In addition, the PCC can determine the force deficit by means of the Bosco index and the optimal load for each player to perform the maximum power.

Table 1. *The tests performed with the encoder and with the platform of contact*

	Handball n = 14	**Basketball n = 15**	**Volleyball n = 10**	**Futsal n = 15**	**Soccer n = 15**	**Field hockey n = 8**	**Mean n = 77**
Encoder							
Force velocity	21.4	13.3	20.0	13.3	13.3	12.5	15.6
Repetition velocity	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Platform of contact							
SJ	28.6	66.7*	60.0*	33.3	40.0	12.5	41.6
CMJ	50.0	66.7*	60.0*	33.3	53.3	25.0	49.4
CMJA	7.1	53.3*	30.0*	33.3	20.0	0.0	26.0
BDJ	21.4	40.0	40.0	6.7	13.3	0.0	20.8
LCMJ	0.0	20.0	10.0	13.3	6.7	0.0	9.1

*Data are expressed in percentages. * denote $p < 0.05$ compared with the others sports.*
SJ = squat jump, CMJ = countermovement jump, CMJA = countermovement jump with the arm swing, BDJ = bounce drop jump, LCMJ = loaded countermovement jump.

In addition, both technologies were used three or more times at season for less than the 5% of the teams. Due to the variability of practical applications of the platform of contact and especially of the encoder, and the difficulty to control numerous parameters by means of another methodologies; the results of this study show, that at least in great part, in the teams examined exist absence of scientific control of the strength training. The poor scientific formation reported in a previous study in the PCCs analysed (Reverter et al., 2008) and various aspects associated to the team sports, requirements of the competition calendar, variability of performance factors and the numbers of players can explain these results.

These results should serve of reflection so as to the PCCs of these teams question their methods of the strength diagnosis and highlight the need of improvement strategies in the dissemination of scientific knowledge associated to the control of strength training toward the coaches involved in the development of elite athletes.

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